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PRELIMINARY REPORT OF THE COMMITTEE ON TESTING THE RESULTS OF GEOMETRY TEACHING.

This committe was appointed for the purpose of testing in as scientific a manner as possible the results obtained from the study of geometry. The right of geometry to the prominent place which it has hitherto held in the curricula of most high schools and preparatory schools has been challenged on the ground that it does not provide for the ordinary student an essential element of his education which could not be provided more satisfactorily in some other manner. Also the traditional method of teaching geometry has been adversely criticized and several new methods have been suggested and to some extent put into practice. This committee has assumed that its work consisted primarily in testing the results of geometry teaching in order to determine whether those criticisms are justified. To reach reliable conclusions in regard to the position of geometry in the curricula, it is necessary that tests be devised of a non-geometrical nature so that they could be given to students whether they have studied geometry or not. To test the second point, some of the tests at least should be geometrical in character but the non-geometrical tests, given for the first purpose, would probably also throw light on the second.

The committee considered what particular results of geometry teaching were most likely results unique to the subject of geometry, and to answer that question, a number of prominent mathematics teachers were asked to state definitely their opinion on that point. After receiving a number of replies, the committee selected two such results for the purpose of testing, namely:

Ability to reason logically, and

Ability to express one's self with precision.

Under the general head of ability to reason logically, the committee would include the following statements which have been made by different individuals but which seem to be inseparable as far as testing purposes are concerned, namely:

Ability to tell whether a given argument is logically sound.

Ability to do logically sound thinking.

Ability to construct a train of reasoning from given material.

One of the first tasks, therefore, which the committee has undertaken is that of preparing suitable non-geometrical tests to determine the results as to reasoning ability, and considerable difficulty has been experienced in preparing such tests. Indeed the committee is not sure that it is possible to prepare reliable tests of that character.

The following five questions indicate the nature of such tests as far as the committee has been able to devise them or find them already prepared:

NON-GEOMETRICAL QUESTIONS FOR TESTING REASONING ABILITY.

1. If John agrees to join the football team provided Charles joins it, but Charles decides not to join it, what follows about John? If John joins, but Charles does not join, is John breaking his agreement? (Modified from the first preliminary report of this committee.)

2. If all solids were crystals, then which of the following statements would necessarily be true, which could not be true, and which might be true:

(1) All crystals are solids.
(2) Some solids are not crystals.
(3) Some things are neither crystals nor solids.
(4) No crystals are liquids.
(5) Some solids are crystals.

3. All the members of a club are invited to compete in a certain athletic contest. Some members of the club are women. What conclusions (if any) can be drawn from the above statements?

4. Do you discover any defects in the reasoning in the following? Bullies are always cowards, but not always liars; therefore, liars are not always cowards.

(Numbers 2, 3, and 4 are modifications of suggested tests given in a paper by Professor Metzler in *The Journal of Educational Psychology.*)

5. A certain club wishes to select the evening of the week for

its regular meeting which will be most satisfactory to its membership. The secretary wrote to each member, asking that each member let him know what evening would be most satisfactory. Can you suggest any other information that would have been better for the secretary to have asked for, and if so, why?

The committee desires very greatly that each member of this Association send to it questions of a non-geometrical character which could be given to high school students. When a large collection of such questions has been gotten together by the committee, an effort will then be made to test each of these questions in regard to its reliability in indicating the reasoning power of persons to whom the question might be given. The committee has in mind, when speaking of testing these questions, the carrying out of some correlation tests such as those explained in the recent books on mental measurements.

After each question has been tested and the coefficient of reliability for each determined, then the committee will group those questions whose coefficient of reliability is sufficiently high, into sets such that a whole set of them might be given to a class in a reasonable time, say one hour, and such that the set would probably give, in the case of each student, a reliable estimate of that student's reasoning ability. These sets of questions would then be given to several hundred persons, indeed possibly to several thousand persons, if sufficient assistance will be rendered the committee by the members of this Association who are teaching high school pupils.

These tests should of course be given under very definite and exactly known conditions and the committee has prepared a set of rules under which the tests would be given and the papers marked. A copy of these rules accompanies this report and the committee would be very much pleased to have suggestions from the Association that would help to improve them.

The committee has also planned to obtain in the case of each individual who takes these tests certain information which would assist in analyzing the results when they are obtained. Statements of the information to be asked for accompany this report.

If these tests should show that the pupils who had studied geometry were superior in reasoning ability, the question would still not be fully settled as to whether that superiority was due to the fact that they had studied geometry, or was due to natural ability to reason logically. With this in view, the committee has planned to give to some classes who are studying geometry a succession of tests; say, one before beginning the study of geometry, others at various times during the course, and one at the conclusion of the subject; to determine whether or not the ability to reason on non-geometrical subject matter was increased during the study of geometry.

The committee has planned to give also a test of a non-geometrical character which would aim to determine whether or not students who had studied geometry had the ability to express themselves with greater precision than those who had not studied geometry.

The plans for this test are simply that an ordinary elementary test in the writing of English composition would be given by giving to the pupils a list of subjects about any one of which they might write a few hundred words, allowing them to select one subject and then write a short composition on it. This composition would then be marked with reference to its precision of expression by persons experienced in marking composition papers, and the results tabulated according to whether the student had studied geometry or not.

To carry out these plans, a considerable period of time will be needed. Also a large amount of work and an appreciable expense will be involved. The committee has been seeking other associations, both abroad and in this country, with whom some plans of co-operation may be formed so that the work may be done more effectively and incidentally the labor and expense be distributed more widely. Moreover the committee has learned of one research student and is seeking others who may possibly carry out a large part of the investigation in connection with their researches. However, the approval of this report and the instruction of the committee to proceed will be interpreted as carrying with it an obligation on the part of the Association to meet the necessary expense.

Rules for Carrying Out the Tests.

Note: These are the rules to be followed after the coefficients of reliability for individual questions have been determined and the questions have been formed into sets as explained in the report.

1. Each person taking the tests should be provided with examination books of uniform size and quality, which should be numbered so that every person taking a test will thereby be assigned a unique number, and neither the person's name nor any information about him should be placed on it.

2. There should be filled out, for each person taking a test, a blank form (see form 1), giving certain information about him.

3. There should also be filled blank forms (see form 2 or form 3), giving certain other information about each person taking a test. One blank will be sufficient for a whole class or any group in which the information called for is common to every individual of the group.

4. Each paper should be read by two or more experienced readers and a mark recorded by the proper identifying number. The reader should have no information about the persons whose papers he reads and no reader should place on the papers any marks or notations of any kind.

5. The marks obtained by those readings, together with the information on the accompanying forms, should then be tabulated and analyzed by expert statisticians.

Testing the Results of Geometry Teaching.

Form 1.

(The name and identifying number should be filled in by the person taking the test before or just when he hands in his paper; the remainder can be filled in at any time.)

Name of person taking the test ....

Identifying number found on the examination book used by him........

Age ....

Has he taken a course in plane geometry which consisted chiefly of the usual logical proofs? ....

Age when that course in geometry was begun ....

Any school activities that might have specially influenced his mental qualities ....

....

Any activities outside of school that might have a special bearing on his mental qualities ....

Testing the Results of Geometry Teaching.

Form 2.

(For persons who have studied geometry.)

(In most cases to be filled out by the teacher.)

The following information applies in common to all those persons whose identifying numbers are in the following list of numbers.........

....

1. Name the text-book used ....
2. How much time has been given to recitations in geometry?
   ....periods per week for................weeks
3. If a full text or a suggestive text was used, were
   (*a*) theorems assigned for study from the text before class development? ....
   (*b*) theorems developed in class before assignment for study? .....
4. Were methods of reasoning and methods of attack given specific discussion? ....
5. Were any so-called originals done
   (*a*) in class discussion? ....
   (*b*) individually? ....
6. What other subjects have been studied that might have helped appreciably in developing their reasoning ability? ....
7. If geometry was studied during the week immediately preceding the test, give on the back of this blank a specific statement of the exact work during the recitation period and in home study for that week? ....
   ....

Testing the Results of Geometry Teaching.

Form 3

(For persons who have not studied geometry.)

The following information applies in common to all those persons whose identifying numbers are in the following list of numbers.........

....

1. What subjects have been studied that might have helped appreciably in developing their reasoning ability? ....
   ....

George Gailey Chambers, *Chairman,*
University of Pennsylvania, Philadelphia, Pa.
Fletcher Durell,
Lawrenceville School, Lawrenceville, N. J.
C. B. Upton,
Teachers College, Columbia University, New York City.